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ABSTRACT

Computers have become an integral part of most college and high school programs; however, the utilization of computers at the elementary level has lagged behind. This paper focuses on the efforts of a New Jersey public school district to expand computer education into the elementary school environment. It describes the second year of a 3-year plan to put a computer laboratory in each elementary school in the district and to implement an educational program that integrates the computer into the existing curriculum. The basic plan fosters the use of the computer as a tool in the learning process without overloading the elementary curriculum. A complementary element of the plan includes a method of providing teacher inservice on a relevant, purposeful, on-going basis. This stage of the project includes: (1) a reexamination of the philosophy guiding the plan; (2) responses to obstacles that have surfaced in the implementation of the program; and (3) assessment of the success of the program and modifications made to long-range plans. Seven addenda offer sheets of information about computer uses in the classroom. (15 references) (LL)

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Elementary Computer Labs That Integrate Curriculum

Robert J. Rodgers

Society's increased dependence on technology and information processing necessitates that the use of computers be an integral, entrenched part of educational programs at all levels. Computers have now evolved past the "fad" or "frill" stage and have become an integral part of most college and high school programs. However, the utilization of computers at the elementary level has lagged behind. This is due to a number of factors such as: the cost, the priority to commit resources at the high school level first and the reluctance to add anything to the already "crowded" curriculum at the elementary level. On the brighter side, computers are now beginning to infiltrate the elementary schools in substantial numbers and in ways that make a significant impact to the elementary school program.

This presentation focuses on the efforts of a New Jersey public school district to expand computer education into the elementary school environment. More specifically, it focuses on the second year of a three year plan to put a computer lab in each elementary school in the district and to implement an educational program that integrates the computer into the existing curriculum. The basic plan fosters the use of the computer as a tool in the learning process without overloading the elementary curriculum. A complementary element of the plan includes a method of providing teacher inservice on a relevant, purposeful, on-going basis.

Examining this stage of the project is of particular interest since it includes: reexamining the philosophy that has guided the plan, response to obstacles that have surfaced in the implementation of the program, assessment of success of the program and modifications made to the long-range plans. Also included in this examination will be: the background of the district's existing program, the plan itself, examples of the curriculum, and a review of opinions and comments found in recent literature.

Philosophy

The basic philosophy guiding this project is that we have now evolved beyond computer literacy. The computer and other technologies such as CD-ROM, large screen projection units, camcorders, VCRs, videodisks, telecommunications and scanners are tools that need to be incorporated into our educational programs to better prepare our students for our information hungry society. Use of the computer (and other technologies) should be as a method or medium, not the focus of study. While knowledge of capabilities and limitations is necessary to utilize the technology effectively and efficiently, the focus in our educational programs should be on the utilization. The computer should be used as a tool to process information and ideas, leading to better problem solving and decision making.

The program is based on the use of the computer as a "means to the end" by using software for word processing, databases and spreadsheets. Word processing aids in the communication of ideas to others. It eliminates the tedium of recopying and makes it easier for the learner to concentrate on clarifying and expanding ideas, editing and organizing documents. This allows the learner to concentrate on content because the mechanics of changes, additions and corrections become less laborious. Databases give the student access to vast amounts of information while making the retrieval of data less laborious. The student can focus on organizing and interpreting facts rather than on locating them. Spreadsheets provide yet another problem solving tool that students can use to create models, analyze data and predict outcomes. It is the perfect "what if" tool used in critical thinking.

Also, an important consideration in implementing the use of the computer across the curriculum is the necessity to inservice the teachers of the students in the program.

Background

The school district under examination is the Marlboro Township Public School District, located in central New Jersey. It is a suburban K-8 district with approximately 3,800 students. It contains 5 elementary schools K-6, with student populations ranging from 500 to 750 students each. It also contains a middle school for grades 7 and 8. High school students attend a regional high school district.

Before the advent of this program, the middle school had 2 computer labs with Apple IIe computers and a curriculum based on the LOGO programming language. Each elementary school had a handful of Apple IIe or IIgs computers dispersed around the building. On the average, each computer would be shared by 2 or 3 teachers. The use of the computers varied greatly from classroom to classroom, depending primarily on the interest and comfort level of the teacher. The existing computer education curriculum was basically computer literacy. Thus, the computers were used primarily to supplement the regular educational program, not really as part of the curriculum. Student use tended to be restricted to individuals or small groups. Often this would result in use for enrichment activities or drill and practice. One could argue that this arrangement put the computers in the hands of the students who were likely to have a computer at home and could handle it independently. Thus, this did not meet the needs of many students who did not have access to a computer at home and who were in the most need of access to computers.

Minimal training was provided for the staff, which left most of them in the same position as the students. Those who had access to a computer at home were more likely to use the computer in their classroom, and those who did not, avoided utilizing the computer. The training that was provided by the district was in the form of a "workshop" at the beginning of the summer. It focused primarily on the use of commercial software. By the start of the following school year, both confidence and enthusiasm had faded.

In April of 1990, the Board of Education approved a 3 year plan to improve the computer education program at the elementary school level. As Phase 1, a computer lab was built in one elementary school over the summer of 1990 and the new program implemented for the 1990-91 school year. Phase 2 produced two more labs for the 1991-92 school year. The remaining 2 schools are scheduled to get their computer labs for the 1992-93 school year, as Phase 3.

Basic Assumptions

A few basic assumptions need to be noted:

1. The district was making a commitment to improve computer education.
2. This program was not designed to save money - it was realized that the price tag would be substantial.

3. The program was not designed to be the easiest nor the most convenient, but was designed to be the best program that we could deliver under the circumstances(funds,space,time,etc).
4. The desire was to improve the total educational program for our students.

The Marlboro Program

In the first phase of this 3 year plan, a computer lab was built in the smallest elementary school. Due to the time needed for architectural drawings and state and local inspections and approvals, the actual construction of the lab began in August 1990 and was completed in October 1990. Two classrooms that were separated by a folding door were converted into a computer lab with 24 workstations. Apple IIe computers from the middle school and Apple IIe and IIgs computers from within the building were used to equip the lab. The money for the project was invested in more up-to-date Macintosh SE computers to replace the computers displaced at the middle school. Thus, for about $50,000; the middle school program was improved and the elementary lab was equipped.

During the summer of 1990, a new computer education curriculum for grades 4 through 6 was developed. The curriculum was developed by a committee of teachers and supervisors. A veteran teacher from within the district with computer expertise and knowledge of the "regular classroom" curriculum was hired as the district's first elementary computer lab teacher.

The proposed schedule for classes in the lab included sessions twice a week for grades 4 and 5, and once a week for grade 6. For the first half of the year, the classes came to the lab during the time devoted to Language Arts instruction. The content of the computer education curriculum during this time was built around word processing and the Language Arts curriculum. For the third quarter of the year, lab time came from Science or Social Studies instructional time and used databases with information for those content areas. For the fourth quarter, time came from mathematics and computer class encompassed spreadsheets and mathematical concepts. The program Appleworks was used for all three applications. For students in grades K through 3, the lab was made available, on request, when it was not scheduled for grades 4 through 6 and the computer teacher was available.

When the regular teacher brought her/his class to the computer lab, she/he stayed in the lab. This served three purposes: to share in the responsibility of supervising the students, to assist students on the basis of content area and the assignment, and to learn with the students as inservice training. In addition, each team of grade level teachers was scheduled for at least one 40 minute session a week with the computer lab teacher for the purpose of lesson planning and development. During these sessions, the regular classroom teachers had the availability of the computer lab teacher's expertise for small group/individual training and the availability of the equipment for exploration, for practice and for utilization in creating instructional materials.

At the same time, the middle school curriculum was developed to extend the elementary curriculum, to introduce the students to using hard drives and to utilize a graphics based environment.

In the second phase, a computer lab was constructed in the largest elementary school (student population 750) and in a middle-sized school (600 students). Two teachers, with at least 3 years of experience in operating computer labs in other districts, were hired to staff the new labs. The curriculum used in the two new labs and in grade 4 in the first school is a revised version of the originally developed grade 4 curriculum. The grade 5 curriculum is now being implemented for the first time in the first school. While the fourth grade curriculum includes a substantial amount of instruction in using Appleworks, the grade 5 curriculum focuses more on applying and extending those skills.

In phase 2, the remaining Apple IIe computers at the middle school were incorporated within the new elementary labs and much of the money spent was invested in Macintosh LC computers for the middle school. These color computers formed the 8th grade lab and the lab equipped last year with Macintosh SE computers became the 7th grade lab. Thus, once again the newest technology was placed in the hands of the older students.

In addition to creating a lab in each of the two remaining elementary schools, the third phase will introduce the grade 6 curriculum at the first school, the grade 5 curriculum in the phase 2 schools and a new multimedia curriculum at the middle school.

Program-Curriculum

The curriculum developed includes 5 basic components: computer awareness, word processing, databases, spreadsheets and integration of commercial software. The scope and sequence of this curriculum is included in Addendum A.

Examples of word processing applications in Language Arts that involve editing documents are included in Addendum B. Examples of writing activities involving the creation of documents are included in Addendum C. These topics were extracted from the district's existing Language Arts curriculum. The specific lessons are developed cooperatively by the regular classroom teacher and the computer lab teacher in their planning/training sessions.

Topics for data bases in Social Studies are listed in Addendum D. Some of the databases are created by the teachers and used by the students, some are created as class projects and others are used as individual student projects. Similarly, topics from Science are listed in Addendum E.

Topics for use of spreadsheets in mathematics are listed in Addendum F. A sample activity involving Health/Science is included as Addendum G.

Obstacles Encountered & Modifications Made

The first obstacle encountered in implementing phase 1 was that the lab was not finished by the start of the school year. This was overcome by the computer lab teacher going into the regular classrooms and delivering the lessons on computer awareness and preparing students for use of the lab. The use of a large screen projection unit made demonstrations meaningful and effective. This obstacle was not perceived as a major problem. As a matter of fact, that computer lab teacher utilized this method (for a shorter time) in the second year - by choice. As for phase 2, being able to start construction at an earlier time resulted in both new labs being available at the beginning of the school year.

The second obstacle encountered was the staff's uncertainty of the program itself. Because of the late date of the decision to start the plan, very little articulation and inservice could take place before the beginning of the school year. The success of the first year of the program and increased articulation with the staffs in the phase 2 schools have substantially lessened this apprehension.

The next obstacle was the reluctance of some teachers to utilize their planning time in such a structured, obligated manner. Contractual changes, realization of the need for such shared planning and success of the program have lessened this concern to some degree. The perception of the extent of this obstacle continues to some degree and varies greatly from teacher to teacher.

While the first school, being the smallest, afforded the opportunity to have flexible scheduling that could change each quarter as needed to match the computer application with curriculum area; the larger schools have needed a more rigid scheduling of the computer lab. This has resulted in regular classroom teachers and supplemental teachers needing to adjust their schedules accordingly. So far, this has not been too much of a problem since most teachers have accepted this as an unavoidable situation needed if the advantages of the program were to be realized.

A continuing concern is the issue of keyboarding skills. At the present, this program does not include formal keyboarding instruction. At the middle school, keyboarding is a required course in grades 7 and 8. After all 5 elementary schools have computer labs, this issue will be addressed. For now, additional time for those students needing more time to complete assignments is being arranged.

To supplement the limited availability of unscheduled lab time for use by K-3 students, the computers available to those grades before the advent of the labs have been returned to them for use in the classroom.

Success of the Program

One of the most driving forces continues to be the positive reaction from the students. Both attitudinal and educational benefits have been observed.

Students quickly became comfortable using the computer as a learning tool. They are able to move from the Apple IIe to the Apple IIgs and back again smoothly after a few weeks in the program. They use computer terminology with ease. The regular classroom teacher's presence and understanding of the terminology and processes affirm the computer's use in simultaneously mastering computer skills and skills in the various content areas.

Students are writing longer, more detailed documents. They are much more willing to edit their work, resulting in improved finished documents. Some students that have difficulty in the mechanics of writing with pen or pencil have shown drastic improvement in the development of their writing skills.

Training in the use of databases has brought about an awareness by the students that they need to be knowledgeable about how to obtain desired information. This part of the program will be extended in the grade 5 curriculum since they have learned the fundamentals in grade 4. This skill will be helpful to the students in using the computerized library systems increasingly available in the region.

While the use of spreadsheets has been the least used component so far, students have developed a better understanding of the use of formulas, variables and order of operations.

Many positive outcomes have been realized as teacher inservice. Some of the teachers directly involved in the program that had never touched a computer are using "prep" periods in the lab to create quizzes, word finds, bulletin board materials and spreadsheets to do grades. The growth in their understanding of the terminology associated with computers has been very obvious. They have a better understanding of the processes, capabilities, limitations and applications of the computer as a tool in the various content areas.

Some of the teachers not involved in the focus of the program have looked at the computer lab to see "what can it do for me?" The music teacher has brought classes to the lab to work on programs teaching music theory. The speech teacher has used the computer for scheduling, record keeping and communication to parents. The secretary and clerk have taken advantage of the available inservice and are now moving much of their paperwork and record keeping to computer. The band teacher has setup a database of students, their instruments and homerooms. Art teachers are tapping into the wealth of potentials with the computer. The guidance counselor and nurse have begun putting their records on the computer. Grade level "newsletters" are popping up all over the place. The advent of the computer lab has signaled a new era that incorporates the entire school "family."

Related Opinions/Comments From the Literature

Investigation of recent literature that pertains to implementing computer labs at the elementary level, and related topics, follows:

Gould(1991) explains the approach to integrate technology throughout the entire curriculum at the Indian Creek Elementary School, Indianapolis, Indiana. "Here, first-grade students produce their own multimedia presentations, second and third grade students compose and edit their own stories on word processors; and fourth and fifth graders reinforce classroom

work at home with loaned personal computers." As I have stated earlier, computer labs in elementary schools are not yet widely pervasive. Gould states "When we began building Indian Creek in the mid-1980's, we had few models for a science and technology magnet school at the elementary level." Marlboro has created a program without trying to copy a particular model.

As for inservice training, Gould(1991) points out that "We've made it a point to have every teacher knowledgeable - and - comfortable - with technology." Our program in Marlboro is designed to provide the necessary inservice on an on-going basis, and relevant to the activities in a variety of content areas.

Dervarics(1991) points out, "Staff development is an essential part of St Vrains's restructuring plan. In the past two years, the district has sponsored more than 30 technology-related courses - most offering graduate credits - for 320 teachers." In Marlboro, plans to offer graduate credit courses are under way.

Gould(1991) also points out an important consideration that one must consider in implementing computer labs at the elementary level, "Introducing computers into elementary school changes what these young students will expect from technology in middle and high school." It is for this very reason that we have invested our money in newer technology for our upper grades.

Lewis(1991) states a philosophy similar to that stated earlier as our rationale for using data bases, "Emphasis has shifted from remembering facts presented by a teacher to finding, organizing, and making sense of the wealth of factual information available to today's student."

Willis(1991) supports the notion of this need to teach students in using data bases, "To thrive in this overheated information environment, students must know how to make information serve their needs, advocates of 'information literacy' claim. These experts urge that schools teach students how to recognize when information is needed, how to find it, and how to evaluate it, use it effectively, and communicate it to others."

Lewis(1991) offers another advantage of incorporating technology, "Our technology provides them with access to many modes of information presentation. For some, the world of words is comfortable; others prefer a more visual, auditory, or tactile approach. A learning environment that offers diverse tools can meet the needs of many learners." As stated earlier, we have found that most of our students have raised their achievement level in writing with the use of word processing. We have also found that students with very poor writing skills have realized even a more drastic improvement in their writing skills.

David(1991) ties restructuring and technology together and states, "Together, restructuring and the new technologies are a far more powerful force for change than either would be alone." She further explains, "Technology can act as a catalyst for change in several ways. To begin with, technology can provide the occasion for change - a necessary step in restructuring." She further states, "The presence of technology not only provides an opportunity for change; it also symbolizes that change." Consistent with our goal to provide shared responsibility in lesson planning and involvement during student lab time, David points out, "The introduction of technology fosters interactions among teachers."

Kinnaman(1991) offers suggestions to improve the effectiveness of strategic planning in restructuring and the use of technology: "Yet for the most part, K-12 education has failed to make the transition; we continue to use the methods and materials of the industrial age to prepare our children for life in the rapidly changing information age. Ironically, although technology is a primary cause of the current crisis in education, it can also be a key ingredient in its solution." He also explains that such changes do not happen easily: "A forward-looking strategic plan is not only difficult to formulate, it is also likely to meet with some serious resistance when it comes time for implementation. After all, an effective plan will demand changes in school structure and function, and such systemic change is always difficult to attain." He suggests that leadership encourage the following attitudes:

1. sensitivity to the ways in which people may be threatened by the plan
2. persistence to make even the most difficult changes if they lead to dramatically improved schools
3. flexibility to accommodate a range of variations on the goal or strategy.

Our plan in Marlboro has brought about various changes in the structure of the school and in the function of various staff members. We believe that these changes are improving our educational program and outweigh any negative shortcomings.

As stated earlier, we have evolved beyond computer literacy. O'Neil(1990), in claiming that few signs of broad changes in teaching and learning attributed to computers have been realized, admits "Some of the most widely cited examples of effective computer use reveal important shifts in how schools use the technology; a move away from 'computer literacy' (in which students were taught about the computer and how to program it) and the expansion of software beyond the ubiquitous drill-and-practice programs derided by some critics as little more than electronic workbooks."

Sheingold(1991) contends, "The agendas of active learning, technology, and restructuring - each a powerful vehicle for changing learning and teaching in schools - need to be pursued concurrently to be maximally effective." Consistent with our engaging the regular classroom teacher and their curriculum in the computer education program, Sheingold states, "To the greatest extent possible, students should engage in work that has an understandable, even compelling purpose." Sheingold further states, "Only recently have applications - word processing, database management systems, spreadsheets, and graphics programs - made their way into more than a few classrooms. And only recently have educators been attempting to integrate the use of computers into subject-matter teaching and learning. But technology is not likely to have a qualitative impact on education unless it is deeply integrated into the purposes and activities of the classroom."

Meyers(1991), in explaining three different approaches in implementing computer labs, describes a program similar to ours in the Nyack, New York Public Schools. A key feature in their program is also that the "regular" classroom teacher stays with their class while in the computer lab and develops assignments closely connected with the regular curriculum. Similarly, our program includes regular classroom teachers actively engaged in the lab activities as well as in the planning and development of these activities.

In the report *Accomplished Teachers: Integrating Computers into Classroom Practice*, Sheingold and Hadley(1990) report that 88 percent of the 608 teachers surveyed indicated that computer use had a positive effect on their teaching. They found these teachers perceived a change in expectations of student performance, "They expect more of their students and can present more complex material; greater opportunities for individualization and for students' working independently; and changes in the roles of teachers and students such that classrooms are more student centered and teachers act more as coaches and facilitators."

Sheingold and Hadley(1990) concluded that accomplishments in integrating computers into classroom practice can be realized on a wider scale only if:

1. there is enough technology (and, in particular, enough technology for teachers to have unrestricted access);
2. there is ample support and time for teachers to learn how to use it and to plan for its use;
3. there is a school structure and culture in which teachers are encouraged and expected to take a professional and experimental approach to their work.

In Marlboro, we have found our approach more difficult than one that would have the computer lab used in isolation from the regular classroom. But as David(1991) states, "Restructuring is difficult. Learning to use technology effectively is difficult. Both require learning new ways to teach, which in turn require changing all parts of the education system."

Conclusion

While the road to implement our program has had its share of bumps and potholes, I feel that we have chosen the right road to travel. We have realized success in having our elementary students use the computer in a connected, purposeful manner. Our preparation should extend the horizons for our students in high school, in college, and, more importantly, for life in our technological society.

Our "personalized" inservice approach has also extended the horizons of our teachers and is helping prepare them for life and teaching in our technological society.

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Addendum A

Scope and Sequence

A. Computer Awareness

1. Identification of components of a computer system
2. Proper handling of diskettes & hardware
3. Format of a diskette as a data disk
4. Recognition of the importance of computers
5. Historical developments in the field of computers
6. Moral issues

B. Word Processing

1. Awareness of functions & advantages
2. Terminology
3. Editing existing documents
4. Creation of new documents

C. Data Bases

1. Awareness of functions & applications
2. Terminology
3. Extraction of specified information
4. Creation of data base file & reports

D. Spreadsheets

1. Awareness of functions & applications
2. Terminology
3. Discovery of "what-if" feature
4. Creation of spreadsheet file

E. Integration of Commercial Software

Addendum B

Word Processing Applications in Language Arts
(Activities involving editing existing documents)

1. Correct errors in punctuation, capitalization and spelling in a set of sentences.
2. Correct a set of run-on sentences and sentence fragments.
3. Correct subject-verb agreement in a set of sentences.
4. Add descriptive words to sentences.
5. Develop paragraphs from topic sentences.
6. Add supporting details to paragraphs.
7. Correct spelling with and without use of Spelling Checker.
8. Correct spelling and use of homonyms.
9. Correct use of parallel construction.
10. Sequencing.

Addendum C

Word Processing Applications in Language Arts
(Writing activities involving the creation of documents)

1. Descriptive paragraph(s)
2. Directional paragraph(s)
3. Non-fictional report
4. Story
5. Poetry
6. Book Report
7. Friendly letter
   (Thank You Letter)
   (Invitation)
8. Business letter
   (Letter to Editor)
   (Letter of Complaint)
9. Advertisement
10. Editorial
11. Use of idioms in an essay
12. Creating mood in an essay

Addendum D

Topics for Data Bases in Social Studies

Grade 4

1. New Jersey Counties
2. Famous New Jerseyans
3. States, capitals, regions
4. Indians
5. Regional industry, agriculture

Grade 5

1. Explorers
2. Colonies
3. American wars
4. Famous blacks
5. American inventors

Grade 6

1. Ancient civilizations
2. Time periods
3. Middle East countries

Addendum E

Topics for Data Bases in Science

Grade 4

1. Life cycles
2. Conductors/insulators (electricity)

Grade 5

1. Classification of animals
2. Classification of plants
3. Dinosaurs
4. Elements

Grade 6

1. Rocks
2. Clouds
3. Weather
4. Space
5. Oceanology
6. Planets

Addendum F

Topics for Spreadsheets in Mathematics

Grade 4

1. Calculation of totals
2. Calculation of perimeter
3. Making conversions within a measurement system

Grade 5

1. Calculation of totals
2. Calculation of averages
3. Calculation of perimeter
4. Calculation of area
5. Making conversions within a measurement system

Grade 6

1. Calculations of averages
2. Operations with integers
3. Calculation of perimeter & circumference
4. Calculation of area
5. Calculation of total surface area
6. Making conversions within a measurement system

Addendum G

Example of an activity involving use of spreadsheet
Health/Science

The following is an application of a spreadsheet used to calculate the calories contained in a snack.

item	calories
soda	110
chips	180
candy bar	280
total	570

Then have students replace these items, 1 at a time, with the following items:

apple	28 calories	-- instead of the candy bar
rice cake	35 calories	-- instead of the chips
diet soda	11 calories	--instead of regular soda

After each replacement, have students notice the effect of that replacement. Discuss the importance of these changes in a person's diet.